Fermilab Directorate

MEMORANDUM OF UNDERSTANDING
FOR THE 2002-2003 MESON TEST BEAM PROGRAM

T930

BTeV Straw Prototype Detector

November 5, 2002

INTRODUCTION

E918 (BTeV) is an approved experiment. It requires detector research and development in tracking, triggering, data acquisition, charged hadron identification, electromagnetic calorimetry and muon detection, as well as an extensive effort in simulation and software development. The goal of the present R&D project is to develop the final devices for use in the BTeV experiment. This MOU relates to straw tracking tests that will be carried out using the MTEST beam of the Meson Area during the 2002-2003 run period.

This is a memorandum of understanding between the Fermi National Accelerator Laboratory and those experimenters of E918 who have committed to participate in straw beam tests to be carried out during the 2002-2003 period. The memorandum is intended solely for the purpose of providing a budget estimate and a work allocation for Fermilab, the funding agencies and the participating institutions. It reflects an arrangement that currently is satisfactory to the parties; however, it is recognized and anticipated that changing circumstances of the evolving research program will necessitate revisions. The parties agree to negotiate amendments to this memorandum that will reflect such required adjustments.

I. PERSONNEL AND INSTITUTIONS

BTeV Straw Beam Test Spokesperson:	Alan Hahn, Fermilab
E918 Test Beam Liaison	Charles Newsom
E918 Computing Off-line liaison:	Rob Kutschke, Fermilab
Fermilab liaison physicist:	Erik Ramberg
Beamline physicist:	From Beams Div./External Beams Dept. Currently, Tom Kobilarcik
Particle Physics Division Liaison:	Erik Ramberg
Computing Division Liaison:	Dave Slimmer

The current BTeV Straw Collaboration members are

1.1 Fermilab: A.Hahn, P. Kasper

1.2 Frascati: M. Bertani, L. Benussi, S. Bianco, M. A. Caponero, F. Fabbri, F. Felli, M. Giardoni, A. La Monaca, E. Pace, M. Pallotta, A. Paolozzi

1.3 Southern Methodist University: T. Coan, M. Hosack

1.4 University of California, Davis: P.Yager

1.5 University of Houston: K. Lau, B. Mayes, 1 postdoc, Siva Subramania, Victor Rodriquez, and Yang Song.

1.6 University of Virginia: M. Arenton, S. Conetti, B. Cox, A. Ledovskoy, M. Ronquest, D. Williams, S. Ye, Z. Zhang .

Other commitments:

CLEO: (T.Coan)
FNAL E831/FOCUS analysis: UCD, Frascati
KTeV, Kloe: (UVa)
HERA-B analysi:s (K. Lau-UH)
ALICE: (B. Mayes-UH)
P902 (A.Hahn FNAL)

II. EXPERIMENTAL AREA, BEAMS AND SCHEDULE CONSIDERATIONS

2.1 LOCATION AND FACILITIES

2.1.1 The test apparatus is to be located in the downstream Detector Hut in the MTEST beam line. The enclosure is necessary since the Straw Detector is sensitive to large temperature variations, which are present in the MTEST open areas. In addition, the test-beam Control/Counting Room to the west of the MTEST will be used to house electronics.

2.1.2 Powered racks for electronics and NIM bins should also be made generally available.

2.1.3 Space in cable trays for approximately 20 cables- 7 (34 conductor twisted pair ribbon) cables, 4 SHV RG58 HV cables, 3 BNC terminated RG58, one multiwire (22 gauge 6 conductors) cable to carry DC power to the preamplifiers and one multiwire (22 gauge 6 conductors) carrying data from our environmental monitor on the Prototype detector.

2.1.4 Electronics Racks are needed inside the Hut and inside the Counting Room.

2.1.5 One standard-size table will be required in the test-beam Counting Room. Computer networking to the general Fermilab Network is required. It would be convenient to also have wireless access to the Fermilab Network,

2.1.6 The power requirements are 1 kW of clean power for electronics

2.1.7 The Straw detector will need to be supplied chamber gas at the flow rate equivalent to a change of several volumes/day. This gas may be flammable, but is within the Fermilab Class 0 hazard range. Dry nitrogen gas will be required at the Straw detector as a purge gas. These gas needs may be satisfied by using facilities in the common test- beam gas shed, assuming the needed flammable gas permits for the common facility have been obtained. We currently have a flammable gas permit for our gas system at Lab3 (Fermilab), and this system could, in principle, be used for the test beam run with the understanding that we would need to get a re-approval for our permit.

2.2 BEAM

2.2.2 The tests will use slow resonantly-extracted, Main Injector proton beam focused onto the MTest target. The tests require a beam of untagged, charged particles. Several different momenta may be chosen to maximize detector rates and to study the effect of energy deposit on the Straw Detector efficiency

2.2.3 Intensity: Variable, in the range of 10-100 kHz in an area of 1 square cm. With the current beam line design this is expected to require up to 2 x 10^{11} primary protons per second.

2.2.4 It is anticipated that the straw data will be buffered over a ~1 second spill period, and read out, saved, and, if time is available, analyzed between Main Injector Test Beam cycles.

2.3 SCHEDULE

The goal is to deliver charged particles at the rate stated above for data taking as required by the R&D program over a significant period beginning as close to the start of the run as possible. The group expects to collect data for short bursts of shifts, and to repeat some of the tests several times. The total time required is not that large but flexibility in scheduling is important. The group expects to share beam time with other R&D efforts. Details are given in the section below labeled Run Plan.

III. RESPONSIBILITIES BY COLLABORATING PHYSICS GROUP

([] denotes replacement cost of existing hardware.)

3.1 Fermilab

Fermilab physicists will be responsible for the trigger, data acquisition and monitoring, software and web support, and contribute to the data analysis.

3.1.1	A straw prototype detector consisting of 2 modules of 48 1-meter straws. The straws are close packed into 3 planes	[$20 k]
3.1.2	Local pair of Scintillator paddles	[$ 1k]
3.1.3	Low and high voltage power supplies for Straw electronic devices	[$ 5k]
3.1.4	Readout electronics for the above devices	[$20k]
3.1.5	DA computer	[$ 6k]
3.1.6	Chiller to bubble chamber gas through ethyl alcohol at ~0degrees C	[$ 1k]
3.1.7	Misc. cables	[$ 1k]
3.1.8	Shop time for construction of Straw Detector Stand	[$ 2k]
3.1.9	Tektronix Digital Oscilloscope	[$ 5k]
3.1.10	Misc. expendables and services	$ 2k
	Total existing items	**[$63k]**
	Total new equipment items	**0**
	Total operating cost	**$ 2k**

3.2 INFN, Frascati

Frascati collaborators will assist in the setup of the straw tests, participate directly in the tests, and contribute to the data analysis.

3.2.1 One full time graduate student for 1 month at Fermilab
3.2.2 Operating funding ($ 15 k) requested of INFN for travel, etc.

Total existing items	**[$ 0 k]**
Total new equipment items	**$ 0 k**
Total operating cost	**$ 15 k**

3.3 Southern Methodist University

SMU will request $5k in travel money from DOE for 3 wk total post-doc (M. Hosack) visit to assist in shift taking. Funding will also be applied to faculty member (T. Coan) travel for 2 shorter visits.

Total existing items	**[$ 00 k]**
Total new equipment items	**$0 k**
Total operating cost	**$ 5 k**

3.4 University of California, Davis

UC Davis collaborators will contribute to the data analysis.

Total existing items	**[$0 k]**
Total new equipment items	**$ 0 k**
Total operating cost	**$ 00 k**

3.5 University of Houston

University of Houston collaborators will assist in the setup of the straw tests, participate directly in the tests, and contribute to the data analysis. Kwong Lau, Bill Mayes and postdoc will travel to Fermilab as needed to participate in the test. The UH group is interested in studying aging of straws in a hadron beam environment, even though the dose for the entire run is expected to produce negligible aging. We are also interested in developing track-finding algorithms for straws for off-line analysis of the test data.

3.5.1 One full time physicist (Kwong Lau, Bill Mayes, postdoc) for 2 months at Fermilab
3.5.2 Operating funding ($ 10 k) requested of DOE for travel and per diem.

Total existing items	**[$ 0 k]**
Total new equipment items	**$ 0 k**
Total operating cost	**$ 10 k**

3.6 University of Virginia

UVa collaborators will assist in the setup of the straw tests, participate directly in the tests, and contribute to the data analysis. They are also responsible for integrating in the Silicon Tracker into the Straw DAQ.

3.6.1 Two full time physicists (Mike Arenton, Sasha Ledovskoy) for three months total each at Fermilab during the test period. Four students (Michael Ronquest, David Williams, Zhang Zhe, Songbai Ye) for varying periods of time depending on academic schedule (total dwell time of three person months). Two faculty (Sergio Conetti, Brad Cox) making periodic trips (~5 each) of one to two weeks. Estimated 30 round trips to Fermilab total. Operating funding ($35 k) requested of DOE for travel, housing, per diem.

3.6.2 New equipment consisting of equipment to support the test including that necessary to integrate the Silicon Tracker into the Straw DAQ and the software (example: data base software) necessary for analysis of data, and, finally, equipment necessary to diagnose beam effects on straw detector items. Equipment funding ($10k) requested of DOE.

Total existing equipment items (including exisiting computing equip.)	**[$ 5k]**
Total new equipment items cost	**$ 10 k**
Total operating cost	**$ 35 k**
Grand Total new operating plus equipment request	**$ 45k**

3.S Summaries of Section 3

3.S.1 Summary of Collaboration Responsibilities

Test beam coordination (area, environment, cable tray, racks, crates, and coordination with other groups) – Fermilab

Mechanical support – Fermilab

Trigger - Fermilab

Data Acquisition – Fermilab and UVa

Monitoring and Event Display – Fermilab

Test Beam shifts –Fermilab, Frascati, UH,and UVa

Offline Software (including data bases, run log, and web: development, maintenance) Fermilab, Frascati, SMU, UCD, UH, and UVa,

3.S.2 Summary of Non-Fermilab Costs

	Equipment	Operating
Total existing items	**[$ 5 k]**	
Total new items	**$ 10 k**	**$ 65 k**

IV. RESPONSIBILITIES BY FERMILAB DIVISION

([] denotes replacement cost of existing hardware.)

4.1 Fermilab Beams Division

4.1.1 Use of MTest beam line.

4.1.2 Maintenance of all existing standard beam-line elements (such as SWICs, loss monitors, remotely-controlled finger counters, etc), instrumentation, controls, clock distribution and power supplies.

4.1.3 Logic signal at experimenter electronics racks that has a constant phase (within 1-2 ns in a given hour) with respect to the arrival of beam buckets at the test apparatus.

4.1.4 No experiment-owned devices need interfacing to the Beams Division control system, other than the possible readout of beam-line variables of 4.1.3.

4.1.5 The test-beam energy and the rest of the beam-line elements will be under the control of the Main Control Room

4.1.6 Position and focus of the beam on the experimental devices under test will be under control of the BD Operations Department (MCR). Control of secondary devices that provide these functions may be delegated to the experimenters as long as it does not violate the Shielding Assessment or provide potential for significant equipment damage.

4.1.7 The integrated effect of running this and other SY120 beams will not reduce the antiproton stacking rate by more than 5% globally, with the details of scheduling to be worked out between the experimenters and the Office of Program Planning.

4.1.S Summary of Beams Division costs:

	Equipment	Operating	Personnel (person-weeks)
Total new items	$ 0 k	$ 0 k	0
Total	$ 0 k	$ 0 k	0

4.2 Fermilab Particle Physics Division

The test-beam efforts in this MOU will make use of the Meson Test Beam Facility. Requirements for the beam and user facilities are given in Section 2. The Fermilab

Particle Physics Division will be responsible for coordinating overall activities in the MTest beam-line, including use of the user beam-line controls, readout of the beam-line detectors, and MTest gateway computer Costs under this section will be funded from BTeV R&D accounts.

4.2.1 Tools and supplies for MTest	$ 1.0k
4.2.2 Two Unistrut stands for trigger counters	1.0k
4.2.5 Survey of detectors on beamline (straw detector fiducials)	1.0k
4.2.6 Installation and wiring of two relay racks in counting room.	0.4k
4.2.7 Cable tray installation as needed	0.8k
4.2.8 Installation of gas lines for Chamber Gas and N2 flushing.	0.4k
4.2.9 Installation of quiet power to detector enclosure if required to reduce noise in electronics	2.0k
Provision of adequate air-conditioning and cooling for the electronics alcove, and the counting room.	

4.2.S Summary of Particle Physics Division costs:

	Equipment	**Operating**	**Personnel (person-weeks)**
Total existing items	**$ 0 k**		
Total new items	**$ 6.6 k**	**$ 0 k**	**1**
Totals	**$ 6.6 k**	**$ 0 k**	**1**

4.3 Fermilab Computing Division

4.3.1 A single connection to the wide-area-network will be required. An additional connection (wireless) would be desirable (~$300).

V. SUMMARY OF COSTS

Source of Funds [$k]	**Equipment**	**Operating**	**Personnel** (person-weeks)
Beams Division	$0k	$0k	0
PPD (BTeV R&D)	0	8.6k	1
Computing Division	0.3k	0k	0.1
Totals Fermilab	0.3k	8.6k	1.1
Totals non-Fermilab	10k	65k	0

VI. SPECIAL CONSIDERATIONS

6.1 The responsibilities of the BTeV Straw Test Beam Spokesperson and procedures to be followed by experimenters are found in the Fermilab publication "Procedures for Experimenters" (PFX). The Physicist in charge agrees to those responsibilities and to follow the described procedures.

6.2 To carry out the experiment a number of Environmental, Safety and Health (ES&H) reviews are necessary. The procedures to carry out these various reviews, including a Partial Operational Readiness Clearance document in conjunction with the standing Particle Physics Division committee, are found in the Fermilab publication "Review Procedures for Experiments" (RPX). The BTeV Straw Test Beam Spokesperson charge undertakes to follow those procedures in a timely manner.

6.3 All regulations concerning radioactive sources will be followed. No radioactive sources will be carried onto the site or moved without the approval of the Fermilab ES&H section.

6.4 All items in the Fermilab Policy on Computing will be followed by experimenters.

6.5 At the time of purchasing, the Fermilab procurement policies shall apply. For the purpose of estimating budgets, specific products and vendors may be mentioned within this memorandum. At the time of purchasing, the Fermilab procurement policies shall apply. This may result in the purchase of different products and/or from different vendors.

6.6 The BTeV Straw Test Beam Spokesperson will undertake to ensure that no PREP and computing equipment be transferred from the experiment to another use except with the approval of and through the mechanism provided by the Computing Division management. They also undertake to ensure that no modifications of PREP equipment take place without the knowledge and consent of the Computing Division management.

6.7 The BTeV Straw Test Beam Spokesperson will ensure that at least one person is present at the Meson Test Beam Facility whenever beam is delivered.

6.8 Each institution will be responsible for maintaining and repairing both the electronics and the computing hardware supplied by them for the experiment. Any items for which the experiment requests that Fermilab performs maintenance and repair should appear explicitly in this agreement.

6.9 If the experiment brings to Fermilab on-line data acquisition or data communications equipment to be integrated with Fermilab owned equipment, early consultation with the Computing Division is advised.

6.10 At the completion of the experiment:

6.10.1 The BTeV Straw Test Beam Spokesperson is responsible for the return of all PREP equipment, Computing equipment and non-PREP data acquisition electronics. If the return is not completed after a period of one year after the end of running the BTeV Straw Test Beam Spokesperson will be required to furnish, in writing, an explanation for any non-return.

6.10.2 The experimenters agree to remove their experimental equipment as the Laboratory requests them to. They agree to remove it expeditiously and in compliance with all ES&H requirements, including those related to transportation. All the expenses and personnel for the removal will be borne by the experimenters.

6.10.3 The experimenters will assist the Fermilab Divisions and Sections with the disposition of any articles left in the offices they occupied, including computer printout and magnetic tapes.

6.10.4 An experimenter will report on the test beam effort at a Fermilab All Experimenters Meeting.

SIGNATURES:

___________________________________ / / 2002
Alan Hahn, BTeV Straw Test Beam Spokesperson, FNAL

___________________________________ / / 2002
John Cooper, Particle Physics Division

___________________________________ / / 2002
Roger Dixon, Beams Division

___________________________________ / / 2002
Vicky White, Computing Division

___________________________________ / / 2002
William Griffing, ES&H Section

___________________________________ / /2002
Hugh Montgomery, Associate Director for Research, Fermilab

___________________________________ / /2002
Steven Holmes, Associate Director for Accelerators, Fermilab

___________________________________ / / 2002
Michael Witherell, Director, Fermilab

___________________________________ / / 2002
Joel Butler, BTeV Co-spokesperson

___________________________________ / / 2002
Sheldon Stone, BTeV Co-spokesperson

APPENDIX I – BTEV STRAW 2002-3 RUN PLAN

Assumptions:

8 weeks of running in 4 two-week periods. During three of the two-week periods we would expect to be the primary users. During the fourth period we could be secondary users, but would need primary access to the Silicon Tracker.

Initial setup time will be 2-3 days, with experimenters working 8-12 hours per day. Subsequent setup times will be on the order of an 8 hour shift (assuming we can simply move back into our original location). Individual runs will be on the order of 2-4 hours, with possible need for access to straw detector between runs. Access time is expected to be ~1/2 hour or less under normal conditions. We assume beam downtime to be ~50%, amortized over accelerators, beam lines, and experiment.

The plan for the first running period is to establish operation of the Straw Prototype in a stand-alone condition. We will try to optimize the orientation of the detector to the beam direction to study straw efficiencies and resolutions. We will study the effect of gas mixtures on efficiency and resolution. By varying the beam momentum, we can vary the beam flux. Also we may simultaneously vary the spot size to check for rate dependent effects. With small spot sizes we will study the "dead zones" around our wire centering devices (twisters).

The goal for the second running period will be integrating the Silicon Tracker into our test. This will most likely be needed for high precision resolution studies. We expect to have 50 μm position resolutions (from the Silicon Tracker) at the location of our Straw Prototype Detector. When we are in this mode, we may need full control over the Silicon Tracker, but could be parasitic to other users (assuming they do not need the Silicon Tracker). It is anticipated that these runs could be quite short (1~2 shifts). However it is unclear how long the initial integration with the Silicon tracker will take.

The third 2 week period would be to continue with the Silicon Tracker integrations, if necessary. Once successfully integrated we would take data, in a similar manner as described in the initial period above.

The fourth 2 week period will be used to answer any outstanding questions which may have arisen during the intial runs or after the analysis of the run data. We would anticipate needing the Silicon Tracker for at least a number of runs during this period.

Let t_0 be the start date of the 2002 fixed target test beam program.

t_0- 6 months (or less) Design mounting structure, ready Straw Prototype Detector

	Make sure all Straw personnel have proper Fermilab training Dry run to measure noise performance (assumed to take a few days)
t_0 -	Begin to commission Straw Detector in Stand Alone Mode (First Run Period)
t_0 + 2 weeks	Complete First Run Period
t_0 + 1 month	Analyze data
t_0 + 2 month	Begin to integrate the Silicon Tracker into the DAQ. (Second Run Period) Could be parasitic user of beam
t_0 + 2.5 months	Start Third Run Period—running with Silicon Tracker
t_0 + 3 months	Complete third run period
t_0 + 5 months	Analyze Data
t_0 + 6 months	Start Fourth run
t_0 + 6.5 months	End Fourth run

APPENDIX II – OFF-LINE ANALYSIS PLAN FOR THE 2002 BTEV STRAW TEST

DATA PROJECTION

We will read data from our CAMAC crate system into our daq and then dump it to disk. We currently have local storage of greater than 1 Gbyte. This amount of space will be sufficient for several days of running. Periodically we will dump the data onto larger drives. The data will be also dumped onto CD's, which then can be distributed to our analysis sites.

ANALYSIS PLAN

Analysis will be done at the by all straw collaborators.

APPENDIX III- Prep and DAQ Equipment

At this point, all equipment from Prep (CAMAC and NIM)has already been acquired for “BTeV Straw Prototype Development”. No NEW requests are anticipated.
The DAQ system is based on a Mac 9600 running LabVIEW 6.1 Software and is already in hand.

It should be noted that this “Stand Alone System” has been running for over a year in the Straw R&D program.

APPENDIX IV - Hazard Identification Checklist

Items for which there is anticipated need have been checked

Cryogenics		**Electrical Equipment**		**Hazardous/Toxic Materials**	
	Beam line magnets		Cryo/Electrical devices		List hazardous/toxic materials
	Analysis magnets		capacitor banks		planned for use in a beam line or
	Target		high voltage (> 5 kV)		experimental enclosure:
	Bubble chamber		exposed equipment over 50 V		
Pressure Vessels		**Flammable Gasses or Liquids**			
	inside diameter	Type: X	Ar-Ethane (49-49)+2%Ethanol		
	operating pressure	Flow rate:	30 cc/min		
	window material	Capacity:	0.5 cubic ft		
	window thickness	**Radioactive Sources**			
Vacuum Vessels			permanent installation	**Target Materials**	
	inside diameter	X	temporary use		Beryllium (Be)
	operating pressure	Type	Sr90, Ru104,Fe55		Lithium (Li)
	window material	Strength:	<1 mCi		Mercury (Hg)
	window thickness	**Hazardous Chemicals**			Lead (Pb)
Lasers			Cyanide plating materials		Tungsten (W)
	Permanent installation		Scintillation Oil		Uranium (U)
	Temporary installation		PCBs		Other : Probably Al/ Cu/si
	Calibration		Methane	**Mechanical Structures**	
	Alignment		TMAE		Lifting devices
type:			TEA		Motion controllers
Wattage:			photographic developers		scaffolding/elevated platforms
class:			Other:		Others